CLAIMS

What is claimed is:

1. A magnetron, comprising:

a ring-shaped anode forming a plurality of resonance circuits;

a cathode disposed at an axial center of the anode to emit thermions, separated from the anode by a predetermined space;

at least one permanent magnet provided beside the anode; and

a magnetic flux carrying unit to carry magnetic flux generated by the at least one permanent magnet to the predetermined space.

2. The magnetron as set forth in claim 1, wherein the at least one permanent magnet is spaced apart from the anode by a predetermined interval.

3. The magnetron as set forth in claim 1, wherein the magnetic flux carrying unit comprises an upper magnetic flux carrying unit carrying the magnetic flux to an upper portion of the predetermined space and a lower magnetic flux carrying unit carrying the magnetic flux to a lower portion of the predetermined space.

4. The magnetron as set forth in claim 3, wherein the at least one permanent magnet, the upper magnetic flux carrying unit and the lower magnetic flux carrying unit form a closed magnetic circuit in a normal or reverse order thereof.

5. The magnetron as set forth in claim 3, wherein:

the upper magnetic flux carrying unit comprises an upper pole piece carrying the magnetic flux to the upper portion of the predetermined space and an upper yoke magnetically connecting the permanent magnets with the upper pole piece; and

the lower magnetic flux carrying unit comprises a lower pole piece carrying the magnetic flux to the lower portion of the predetermined space and a lower yoke magnetically connecting the permanent magnets with the lower pole piece.

6. The magnetron as set forth in claim 5, wherein the at least one permanent magnet, the upper yoke, the upper pole piece, the lower pole piece and the lower yoke form a closed magnetic circuit in a normal or reverse order thereof.

7. A magnetron, comprising:

a ring-shaped anode forming a plurality of resonance circuits;

a cathode disposed at an axial center of the anode to emit thermions, separated from the anode by a predetermined space;

at least one permanent magnet generating magnetic flux to be applied to the predetermined space;

upper and lower pole pieces carrying the magnetic flux to upper and lower portions of the predetermined space, respectively; and

upper and lower yokes magnetically connecting the permanent magnets with the upper and lower pole pieces, respectively;

wherein the at least one permanent magnet, the upper yoke, the upper pole piece, the lower pole piece, and the lower yoke form a closed magnetic circuit in a normal or reverse order thereof.

8. The magnetron as set forth in claim 7, wherein the at least one permanent magnet is spaced apart from the anode by a predetermined interval.

9. A magnetron, comprising:

a ring-shaped anode forming a plurality of resonance circuits;

a cathode disposed at an axial center of the anode to emit thermions, separated from the anode by a predetermined space;

at least one permanent magnet provided beside the anode and spaced apart therefrom by a predetermined interval to generate magnetic flux to be applied to the predetermined space; and

a magnetic flux carrying unit to carry magnetic flux generated by the at least one permanent magnet to the predetermined space.

10. The magnetron as set forth in claim 9, wherein the magnetic flux carrying unit comprises an upper magnetic flux carrying unit carrying the magnetic flux to an upper portion of the predetermined space and a lower magnetic flux carrying unit carrying the magnetic flux to a lower portion of the predetermined space.

11. The magnetron as set forth in claim 10, wherein:

the upper magnetic flux carrying unit comprises an upper pole piece carrying the magnetic flux to the upper portion of the predetermined space and an upper yoke magnetically connecting the permanent magnets with the upper pole piece; and

the lower magnetic flux carrying unit comprises a lower pole piece carrying the magnetic flux to the lower portion of the predetermined space and a lower yoke magnetically connecting the permanent magnets with the lower pole piece.

12. A magnetron, comprising:

a ring-shaped anode forming a plurality of resonance circuits;

a cathode disposed at an axial center of the anode to emit thermions, separated from the anode by a predetermined space;

at least one permanent magnet provided beside the anode;

upper and lower pole pieces carrying the magnetic flux generated by the permanent magnets to upper and lower portions of the predetermined space, respectively;

upper and lower yokes magnetically connecting the at least one permanent magnet with the upper and lower pole pieces, respectively, and covering tops and bottoms of the permanent magnets, respectively; and

an attaching unit to attach the permanent magnets to the upper and lower yokes.

13. The magnetron as set forth in claim 12, wherein the attaching unit comprises:

attaching holes formed in the upper and lower yokes, respectively;

through holes formed in the permanent magnets, respectively; and

rivets or bolts adapted to attach the permanent magnets to the upper and lower yokes while passing through the attaching and through holes.

14. The magnetron as set forth in claim 13, wherein the rivets or bolt and nuts are made of non-magnetic or paramagnetic material.

15. The magnetron as set forth in claim 14, wherein the paramagnetic material is aluminum or copper.

16. The magnetron as set forth in claim 15, wherein the upper yoke is provided at one or more side ends thereof with at least one mounting tab that protrudes outside outer surfaces of the at least one permanent magnet, to be used to attach the magnetron to an object.

17. The magnetron as set forth in claim 12, wherein the at least one permanent magnet has an outside surface that exists outside or coincides with radially outer ends of the upper and lower yokes.

18. The magnetron as set forth in claim 12, wherein the at least one permanent magnet has a polarization direction parallel with the axial center direction.

19. The magnetron as set forth in claim 12, wherein the at least one permanent magnet comprises a plurality of magnets that have a same polarization direction.

20. A magnetron, comprising:

a ring-shaped anode forming a plurality of resonance circuits;

a cathode disposed at an axial center of the anode to emit thermions, separated from the anode by a predetermined space;

at least one permanent magnet provided beside the anode to be longer than the anode in an axial center direction of the magnetron; and

a magnetic flux unit to carry magnetic flux generated by the at least one permanent magnet to the predetermined space.

21. The magnetron as set forth in claim 20, wherein the magnetic flux carrying unit comprises an upper magnetic flux carrying unit carrying the magnetic flux to an upper portion of the predetermined space and a lower magnetic flux carrying unit carrying the magnetic flux to a lower portion of the predetermined space.

22. The magnetron as set forth in claim 21, wherein:

the upper magnetic flux carrying unit comprises an upper pole piece carrying the magnetic flux to the upper portion of the predetermined space and an upper yoke magnetically connecting the at least one permanent magnet with the upper pole piece; and

the lower magnetic flux carrying unit comprises a lower pole piece carrying the magnetic flux to the lower portion of the predetermined space and a lower yoke magnetically connecting the at least one permanent magnet with the lower pole piece.

23. A microwave oven, comprising:

a cooking cavity in which food is placed to be cooked;

a heating unit to heat the food, the heating unit comprising:

a magnetron, comprising:

a ring-shaped anode forming a plurality of resonance circuits;

a cathode disposed at an axial center of the anode to emit thermions, separated from the anode by a predetermined space;

at least one permanent magnet provided beside the anode; and

a magnetic flux carrying unit to carry magnetic flux generated by the at least one permanent magnet to the predetermined space, and

a control unit to control an amount of heat produced by the heating unit.

24. The microwave oven of claim 23, wherein the magnetic flux carrying unit comprises an upper magnetic flux carrying unit carrying the magnetic flux to an upper portion of the predetermined space and a lower magnetic flux carrying unit carrying the magnetic flux to a lower portion of the predetermined space.

25. A microwave oven, comprising:

a cooking cavity in which food is placed to be cooked;

a heating unit to heat the food, the heating unit comprising:

a magnetron, comprising:

a ring-shaped anode forming a plurality of resonance circuits;

a cathode disposed at an axial center of the anode to emit thermions;

an activating space formed between the anode and the cathode;

at least one permanent magnet generating magnetic flux to be applied to the activating space;

upper and lower pole pieces carrying the magnetic flux to upper and lower portions of the activating space, respectively; and

upper and lower yokes magnetically connecting the permanent magnets with the upper and lower pole pieces, respectively;

wherein the at least one permanent magnet, the upper yoke, the upper pole piece, the activating space, the lower pole piece, and the lower yoke form a closed magnetic circuit in a normal or reverse order thereof; and

a control unit to control an amount of heat produced by the heating unit.

26. A microwave oven, comprising:

a cooking cavity in which food is placed to be cooked;

a heating unit to heat the food, the heating unit comprising:

a magnetron, comprising:

a ring-shaped anode forming a plurality of resonance circuits;

a cathode disposed at an axial center of the anode to emit thermions;

an activating space formed between the anode and the cathode;

at least one permanent magnet provided beside the anode and spaced apart therefrom by a predetermined interval to generate magnetic flux to be applied to the activating space; and

a magnetic flux carrying unit to carry magnetic flux generated by the at least one permanent magnet to the activating space; and

a control unit to control an amount of heat produced by the heating unit.

27. A microwave oven, comprising:

a cooking cavity in which food is placed to be cooked;

a heating unit to heat the food, the heating unit comprising:

a magnetron, comprising:

a ring-shaped anode forming a plurality of resonance circuits;

a cathode disposed at an axial center of the anode to emit thermions;

an activating space formed between the anode and the cathode;

at least one permanent magnet provided beside the anode;

upper and lower pole pieces carrying the magnetic flux generated by the permanent magnets to upper and lower portions of the activating space, respectively;

upper and lower yokes magnetically connecting the at least one permanent magnet with the upper and lower pole pieces, respectively, and covering tops and bottoms of the permanent magnets, respectively; and

an attaching unit to attach the permanent magnets to the upper and lower yokes; and

a control unit to control an amount of heat produced by the heating unit.

28. A microwave oven, comprising:

a cooking cavity in which food is placed to be cooked;

a heating unit to heat the food, the heating unit comprising:

a magnetron, comprising:

a ring-shaped anode forming a plurality of resonance circuits;

a cathode disposed at an axial center of the anode to emit thermions;

an activating space formed between the anode and the cathode;

at least one permanent magnet provided beside the anode to be longer than the anode in an axial center direction of the magnetron; and

a magnetic flux unit to carry magnetic flux generated by the at least one permanent magnet to the activating space; and

a control unit to control an amount of heat produced by the heating unit.

29. A high frequency apparatus, comprising:

a high frequency particle accelerating unit comprising:

a magnetron, comprising:

a ring-shaped anode forming a plurality of resonance circuits;

a cathode disposed at an axial center of the anode to emit thermions, separated from the anode by a space;

at least one permanent magnet provided beside the anode; and

a magnetic flux carrying unit to carry magnetic flux generated by the at least one permanent magnet to the space,

the magnetron generating a high frequency particle beam; and

a control unit to control an intensity of the high frequency particle beam.

30. The high frequency apparatus of claim 29, wherein the apparatus is one of: a high frequency heating apparatus, a particle accelerator and a radar unit.

31. A high frequency apparatus, comprising:

a high frequency particle accelerating unit comprising:

a magnetron, comprising:

a ring-shaped anode forming a plurality of resonance circuits;

a cathode disposed at an axial center of the anode to emit thermions;

an activating space formed between the anode and the cathode;

at least one permanent magnet generating magnetic flux to be applied to

the activating space;

upper and lower pole pieces carrying the magnetic flux to upper and lower portions of the activating space, respectively; and

upper and lower yokes magnetically connecting the permanent magnets with the upper and lower pole pieces, respectively;

wherein the at least one permanent magnet, the upper yoke, the upper pole piece, the activating space, the lower pole piece, and the lower yoke form a closed magnetic circuit in a normal or reverse order thereof,

the magnetron generating a high frequency particle beam; and

a control unit to control an intensity of the high frequency particle beam.

32. The high frequency apparatus of claim 31, wherein the apparatus is one of: a high frequency heating apparatus, a particle accelerator and a radar unit.

33. A high frequency apparatus, comprising:

a high frequency particle accelerating unit comprising:

a magnetron, comprising:

a ring-shaped anode forming a plurality of resonance circuits;

a cathode disposed at an axial center of the anode to emit thermions;

an activating space formed between the anode and the cathode;

at least one permanent magnet provided beside the anode and spaced apart therefrom by a predetermined interval to generate magnetic flux to be applied to the activating space; and

a magnetic flux carrying unit to carry magnetic flux generated by the at least one permanent magnet to the activating space,

the magnetron generating a high frequency particle beam; and

a control unit to control an intensity of the high frequency particle beam.

34. The high frequency apparatus of claim 33, wherein the apparatus is one of: a high frequency heating apparatus, a particle accelerator and a radar unit.

35. A high frequency apparatus, comprising:

a high frequency particle accelerating unit comprising:

a magnetron, comprising:

a ring-shaped anode forming a plurality of resonance circuits;

a cathode disposed at an axial center of the anode to emit thermions;

an activating space formed between the anode and the cathode;

at least one permanent magnet provided beside the anode;

upper and lower pole pieces carrying the magnetic flux generated by the permanent magnets to upper and lower portions of the activating space, respectively;

upper and lower yokes magnetically connecting the at least one permanent magnet with the upper and lower pole pieces, respectively, and covering tops and bottoms of the permanent magnets, respectively; and

an attaching unit to attach the permanent magnets to the upper and lower yokes,

the magnetron generating a high frequency particle beam; and

a control unit to control an intensity of the high frequency particle beam.

36. The high frequency apparatus of claim 35, wherein the apparatus is one of: a high frequency heating apparatus, a particle accelerator and a radar unit.

37. A high frequency apparatus, comprising:

a high frequency particle accelerating unit comprising:

a magnetron, comprising:

a ring-shaped anode forming a plurality of resonance circuits;

a cathode disposed at an axial center of the anode to emit thermions;

an activating space formed between the anode and the cathode;

at least one permanent magnet provided beside the anode to be longer than the anode in an axial center direction of the magnetron; and

a magnetic flux unit to carry magnetic flux generated by the at least one permanent magnet to the activating space,

the magnetron generating a high frequency particle beam; and

a control unit to control an intensity of the high frequency particle beam.

38. The high frequency apparatus of claim 37, wherein the apparatus is one of: a high frequency heating apparatus, a particle accelerator and a radar unit.